



Reconstructing Sea Ice Cover in Lancaster Sound, Canadian Arctic Archipelago, using the long-lived coralline alga *Clathromorphum compactum*

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Arctic sea ice cover has been rapidly declining since the beginning of satellite observations in the 1970s. However, the limited length satellite records do not allow for an assessment of the long-term behaviour of sea ice, which leads to uncertainties in our ability to project future evolution of sea ice cover. Recently, the shallow benthic coralline alga *Clathromorphum compactum* has been shown to archive annual resolution proxy information of sea ice cover. *C. compactum* is found throughout the Arctic and can exhibit a life-span of up to 650 years while depositing annual growth increments in a High-Mg calcite skeleton. *C. compactum* exhibits no ontogenetic decline of growth with increasing specimen age. Instead, annual growth increment widths and Mg/Ca ratios in this photosynthesizing marine plant are strongly dependent on light availability on the shallow seafloor, where low growth rates and Mg/Ca ratios are related to long duration sea-ice cover. For this study, we have analyzed Mg/Ca ratios using Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry in a specimen of *C. compactum* live-collected from Rigby Bay, northern Lancaster Sound, Nunavut, Canada (74.5°N, 90.1°W) in summer 2016. Mg/Ca ratios in *Clathromorphum* exhibit annual cyclicities, which were used to generate an age model and calculate annual growth increment widths. Results indicate that the specimen exhibits average annual growth rates of 90 μm throughout its lifespan (1863 – 2016). Growth rates have increased from an average of 78 μm (1863-1883) to an average of 103 μm (1994-2014) while at the same time exhibiting multidecadal variability. A comparison of growth increment widths to satellite-derived summer (July to October) sea-ice concentration at the collection site since 1979 indicates a tight negative relationship ($r = 0.5947$, $p < 0.001$, $n = 37$). Spatial correlations with satellite-derived sea ice concentration across the Canadian Arctic Archipelago exhibit highest correlations in the western Lancaster Sound and Barrow Strait region, further confirming the suitability of this specimen for sea-ice reconstructions. The record prior to satellite observations shows an overall sea-ice decline since the mid 19th century. However, long-term variability is indicated by periods of low sea-ice cover from the 1920s to 1950s followed by high sea-ice cover from the 1960s to 1980s. In summary, the time series shows that sea ice decline has been ongoing at least since the beginning of the industrial revolution, while exhibiting its steepest and ongoing decline starting in the 1980s.